

SPECIFICATION

TITLE OF INVENTION:

MODULAR COMPUTERIZED ENCRYPTION SCHEME

CROSS-REFERENCE TO RELATED APPLICATIONS - NOT APPLICABLE

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT - NOT APPLICABLE

REFERENCE TO SEQUENCE LISTING, A TABLE, OR A COMPUTER PROGRAM LISTING

COMPACT DISK APPENDIX - NOT APPLICABLE

BACKGROUND OF THE INVENTION

This invention pertains to the field of cryptography/other (Classification 380/59).

Over the years and centuries, numerous classical cryptography methods have proven to be vulnerable to attack, by frequency analysis or other methods. With the advent and popularization of the personal computer and computerized spreadsheet in the early to mid 1980's, it became possible to design and implement computerized ciphers and encryptions. Furthermore, these computer programs can be designed to be modular, in that the output of one can be fed into the input of another, further increasing the complexity of the encryption. This modularization is the primary claim of this patent. A search of patents with the words "modular" and "encryption" in the title was made, back to 1976 (before the advent of personal computer hardware and software utilized in the creation of this invention). No similar claims were found.

BRIEF SUMMARY

The encryption scheme is modular in that the output of one computerized encryption may be fed into the input of another, and a sequential series of encryptions formed. To facilitate this modularization, each module has an input and output of identical size, an 100 row by 80 column block of text (approximately two single-spaced pages of text).

Additionally, the same module could be used repeatedly, but with its working parameters modified each time. Provisions for this are made by externalizing key parameters in data files accessible to the user. This concept was utilized for Modules 2 thru 6 and could be applied to the design of Module 1 as well.

A brief description of each module follows:

Module 1: A modified Vigenere cipher, of 10 randomized alphabets, with a 18 digit key which determines which substitution alphabets are used. An alphabet of 36 characters, 26 lower case letters and 10 numer, was used.

Module 2: A Hill cipher, using a 10x10 matrix multiplied upon a 10x1 vector (a 10 character sub-block).

Module 3: A “shifting” cipher to shift and intermix rows and columns of the input text block (100 row by 80 columns). Module 3 can be described as a block function operating on a relatively large (100x80) block of text (a “super block”).

Module 4: A poly-alphabetic substitution cipher similar to Module 1 except there are 80 substitution alphabets, one for each column of text to be encrypted. Each alphabet is not randomized as in Module 1 but is determined by a linear equation $ax+b$ where “a” is a four digit number prime with regard to 36, the length of the alphabet. The “prime” stipulation helps eliminate degenerate alphabets.

Module 5: A poly-alphabetic substitution cipher, where there are 36 randomized alphabets and a key text equal in size to the input text, the key text determining which substitution alphabets are used, and in what order.

Module 6: “Noise” is added modulo 36 to the input text, as an encryption, then removed as a decryption.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING - NOT APPLICABLE

DETAILED DESCRIPTION OF THE INVENTION

A detailed description of each module is given below:

Module 1:

The input text is contained in a file “input.dat”, being a text file 100 rows by 80 columns. An alphabet of 26 lower case letters and 10 numerals (total of 36 characters) is used within (inside) this module as well as the others. Here, in this module alone, there are no limitations on characters used in the input file, but for ease of construct, the capital letters are later reduced to lower case letters, and punctuation, blanks and other symbols are allowed to pass through the program unencrypted.

A work-around, or kluge, for Microsoft Fortran only, perhaps: Let the computer read “input.dat” one line at a time in a format “A80”, then write to an internal memory (buffer) as format “A80” but then retrieve from the buffer (read from it) in a format “80A1”. This can convert a single line of “input.dat” into a row of an array, with 80 elements. Useful.

A spreadsheet table is made of some number (10 here) of scrambled or randomized alphabets, for reference. This look-up table is implemented within the computer program’s code by a series of callable Fortran subroutines, each one implementing one substitution alphabet by means of a series of 36 Fortran “if...then” statements. One example of such a statement might be similar to: if (letter.eq.’a’) then letter=’z’. The output text is contained in a file “output.dat”.

A companion computer program is made to decrypt “output.dat” into a new output file “dcrypt.dat”. This program simply has the characters in the “if...then” statements reversed.

A user-input 18 digit key, also using the same 36-character alphabet, is used to specify which substitution alphabets are used, and in what order. For example, a key “ac” might be interpreted as “use alphabet 1 (a=1)

to look up a substitution for the first character to be encrypted, alphabet 3 ($c=3$) for the second character, etc. An 18 digit key was selected as a maximum length easily memorized. If this key were an easily memorized phrase, composed of four smaller words (of length four or five characters), there are approximately 16×10^{12} possibilities (there being, in round numbers, 2000 common four-letter words and 2000 common five-letter words). One example of this type of 18 digit key is “looselipssinkships”. Of course, the introduction of numerals and words not in the dictionary (proper names, place names, foreign words, etc.) increases the number of possible keys, e.g. “ubereigen2506henri”, “babar9802sanssouci”, “eulergammaquidvici”, etc. In this module, two randomly chosen alphabets are added to the 18 character key as padding, since the resulting effective total key length 20 divides evenly into 80, the number of columns of text to be enciphered (the key is used four times per row of input text).

This module could be improved by adding more substitution alphabets or a longer key. Another improvement would be to not embed the substitution alphabets in Fortran “if...then” statements, but to arrange them in a data file which the computer program could read into a data array of 36 rows, each column being one substitution alphabet. This would give the user access to the data file, with the ability to modify the operations of the module externally.

Module 2:

The input text is of the same size and name as in Module 1, but there is a restriction that all characters must be lower case letters or numerals (no blanks or punctuation are permitted due to ensuing operations).

Padding characters may be used to fill the input text block. Initially each character of the input text is converted to a numerical value 0 thru 35, in a one-to-one correspondence, through a single scrambled or randomized substitution alphabet implemented by “if...then” blocks. These values are then taken ten at a time and transformed by an enciphering matrix (10x10) into new values, using matrix multiplication, then later converted back to the familiar 36-character alphabet and released as output. The deciphering process is identical but uses a companion matrix, a deciphering matrix which is the inverse of the enciphering matrix. Both the enciphering and deciphering matrices are supplied to the computer program as data files (changeable should the need arise).

A spreadsheet is used to calculate the 10x10 inverse matrix, the matrix which undoes the encryption. (A spreadsheet solving for the inverse of a 5x5 matrix was performed as an intermediate exercise.) Further spreadsheets are used to calculate the determinate of a 10x10 matrix and a 9x9 matrix (necessary for computing the inverse of the 10x10 matrix). The spreadsheets solving for the inverse matrix incorporate modulo 36 arithmetic not found in ordinary matrix calculators found on the internet. A spreadsheet modeling the computation of an inverse of a 3x3 matrix is the first step.

Module 3:

The same input and output files are used. The input text is inducted into an array. A data file contains instructions for shifting and intermixing the columns of this array. An example of this file might be 0380 which would be interpreted as move column 3 to column 1, move column 80 to column 2, etc. This file is also inducted into a separate array, which can be simply manipulated internal to the program to produce a decoding array. A similar arrangement is made for shifting and intermixing the rows of the input text.

Provisions are made for the user to select an encryption or decryption mode of the program, which results in "input.dat" being encrypted to "output.dat", or "output.dat" being decrypted to "dcrypt.dat", respectively.

Both row and column enciphering arrays are supplied to the computer program as data files (readily changeable if necessary).

Module 4:

Using a spreadsheet, a column of integers 0 thru 35 is formed. In the next column a linear equation $y=(ax+b) \bmod 36$ transforms the first column, where "a" is a four digit integer prime with respect to 36, "b" a small prime such as 5 or 7, and "x" the integer in the first column to be transformed. Using an internet factorization applet and this spreadsheet, eighty suitable integers are discovered and evaluated for forming substitution alphabets, one for each column of text to be encoded. (Integers forming degenerate alphabets, without a one-to-one correspondence (or mapping) from x to y are discarded).

These suitable integers are then placed in a file for access by the program (where they are easily changeable should it be desired). The computer program accepts these 80 integers, uses the equation to generate a substitution alphabet for each integer, and stores the alphabets in a 36 row by 80 column array, each column being an alphabet. This array is used as a substitution table for the text to be encrypted. Again, a simple manipulation of the 36x80 encrypting array results in a decrypting array, and the user is given an option to either encrypt or decrypt, using the same program.

Module 5:

An alphabetic substitution table is imported into the program as a 36 row x 36 column array, each column being one alphabet of 26 alpha and 10 numer characters. An input text, "input.dat", comprised of a message embedded within an 100 row by 80 column padded text, is formed as usual. A "key text", ideally of random, evenly distributed characters, of identical size to "input.dat", is chosen (here the key text was selected from excerpts of the classical texts of Vegetius, Beowulf, and Cicero). All three texts (alphabets, input, and key) are modifiable by the user, external to the computer program, for maximum flexibility. The encryption uses the alphabet table to find the substitution for the inputs of a given key (selects the column of the alphabet table) and a given plaintext character (selects the row of the alphabet table). The decryption first locates the cipher letter in the table, then looks up the input coordinates using the key, to arrive at the original plain text character.

Module 6:

A "noise" text is added modulo 36 to the input text. The noise text is the same as the "key text" of Module 5, and is modifiable by the user. The decryption is the opposite, the subtraction of the noise (key) from the encrypted text. In this module, conversion of the characters "a" thru "z" and "0" thru "9" into the integers "0" thru "35" is required, through a Fortran "if...then" sequence, as performed elsewhere.

Appendix - examples of input and output data files.

An example of the data file 'input.dat' follows. This block has a background (filling or padding) composed from excerpts from the classical texts, Caesar's "Commentaries" and Sun Tzu's "The Art of War". A short "secret" message is embedded at row 23, but any message up to a size 100 rows by 80 columns can be enciphered here.

all gaul is divided into three parts one of which the belgae inhabit the aquitani another those
who in their own language are called celts in our gauls the third all these differ from each other
in language customs and laws the river garonne separates the gauls from the aquitani the marne
and these inese separate them from the belgae of all these the belgae are the bravest because they are
the furthest from the civilization and refinement of our province and merchants least frequently
resort to them and import those things which tend to effeminate the mind and they are the nearest
to the germans who dwell beyond the rhine with whom they are continually waging war for which
reason the helvetii also surpass the rest of the gauls in valor as they contend with the germans in a
most daily battle when they either repel them from their own territories or themselves wage war
on their frontiers one part of these which has been said that the gauls occupy takes its begin-
ning at the river rhone it is bounded by the river garonne the ocean and the territories of the be-
lgae it borders to on the side of these quani and the helvetii upon the river rhine and stretches
toward the north the belgae rises from the extreme frontier of gaul extend to the lower part of the
river rhine and look toward the north and the risings aquitania extends from the river garon-
ne to the pyrenean mountains and to that part of the ocean which is near spain it looks between the
setting of the sun and the north star chapter 2 among the helvetii or getorix was by far the most dis-
tinguished and wealthy he when marcus messala and marcus pisus were consuls incited by lust for
sovereignty formed a conspiracy among the nobility and persuaded the people to go forth from their
territories with all their possessions saying that it would be very easy since they excelled
all in valor to acquire the supremacy of the whole of gaul to this the more easily persuaded them
because the helvetii are confined on every side by the nature of their situation on one side by
the rhine a very broad and deep river which separates the helvetian territory from the germans
on the other the jura a very high mountain which is situated between the sequani and the helvetii on a third
by the lake of geneva and by the river rhone which separates our province from the helvetii from these
circumstances it resulted that they could range less widely and could less easily make war
upon their neighbors for which reason men fond of war as they were were affected with great regret
that they thought that considering the extent of their population and their renown for war fare and
bravery they had but narrow limits although they extended in length 240 and in breadth 180 roman
miles chapter 3 induced by these considerations and influenced by the authority of getorix they de-
termined to provide such things as were necessary for their expedition to buy up as great a
number as possible of beasts of burden and wagon stock to make their journey as large as possible so that
on their march plenty of corn might be in store and to establish peace and friendship with their
neighboring states they reckoned that a term of two years would be sufficient for them to execute
their design they fixed by decree their departure for the third year or getorix is so sent to com-
plete these arrangements he took upon himself the office of ambassador to the states on this jour-
ney he persuaded casticus the son of catamantaledes one of the sequani whose father had possessed
the sovereignty among the people for many years and had been styled friend by the senate of the
roman people to seize upon the sovereignty in his own state which his father had held before him and
he likewise persuaded dumnorix another brother of divitiacus who at that time possessed
the chief authority in the state and was exceedingly beloved by the people to attempt the same and
gave his daughter in marriage he proved to them that to accomplish their attempt was a thing
very easy to be done because he himself would obtain the government of his own state that there
was no doubt that the helvetii were the most powerful of the whole of gaul he assured them that he
will with his own forces and his own army acquire the sovereignty for them incited by this speech
they gave a pledge and oath to one another and hoped that when they have seized the sovereignty they
will by means of the three most powerful and valiant nations be enabled to obtain possession of the
whole of gaul chapter 4 when this scheme was disclosed to the helvetii by informers they according
to their custom compelled getorix to lead his cause in chains it was the law that the penalty
of being burned by fire should await him if condemned on the day appointed for the pleading of

his cause or getorix drew together from all quarters to the court all his vassals to the number of
ten thousand persons and led together to the same place all his dependents and debtor bondsmen
of whom he had a great number by means of those he rescued himself from the necessity of pleading
his cause while the state incensed at this act was endeavoring to assert its right by arms and the
magistrates were mustering a large body of men from the country or getorix died and there is not wan-
ting suspicion as the helvetii think of his having committed suicide chapter 5 after his death
the helvetii nevertheless attempt to do that which they had resolved on namely to go forth from
their territories when they thought that they were at length prepared for this undertaking they
set fire to all their towns in number about twelve to their villages about four hundred and to the
private dwellings that remained they burn up all the corn except what they intend to carry with
them that after destroying the hope of a return home they might be the more ready for undergoing
danger they order every one to carry forth from home for himself provisions for three months
ready ground they persuade the auraci and the tulingi and the latobrigi their neighbors to adopt
the same plan and after burning down their towns and villages to set out with them and they admit
to their party and unite to themselves as confederates the boii who had dwelt on the other side of
the rhine and had crossed over into the norican territory and assaulted no rei chapter 6 there
were in all two routes by which they could go forth from their country one through the sequan in a
narrow and difficult between mount jura and the river rhone by which scarcely one wagon at a time could
be led there was more over a very high mountain overhanging so that a very few might easily inter-
cept them the other through our province much easier and free from obstacles because the rhone
flows between the boundaries of the helvetii and those of the allobroges who had lately been sub-
dued and in some places crossed by a ford the furthest town of the allobroges and the nearest to
the territories of the helvetii is geneva from this town a bridge extends to the helvetii they
thought that they should either persuade the allobroges because they did not seem as yet well af-
fected toward the roman people or compel them by force to allow them to pass through their terri-
tories having provided everything for the expedition they appoint a day on which they should all
meet on the bank of the rhone this day was the fifth before the kalends of april the 28th of march in
the consulship of lucius Piso and aulus Gabinius chapter 7 when it was reported to caesar that
they were attempting to make their route through our province he hastens to set out from the city
and by a great march as he can proceed to further gaul and arrives at geneva he orders the whole
of the province to furnish as great a number of soldiers as possible as there was in all only one legion
in further gaul he orders the bridge at geneva to be broken down when the helvetii are apprized of
his arrival they send to him as ambassadors the most illustrious men of their state in which emba-
ssy numei and veruodotius held the chief place to say that it was their intention to march thro-
ugh the province without doing any harm because they had according to their own representation
another route that they requested they might be allowed to do so with his consent caesar inas-
much as he kept in remembrance that lucius cassius the consul had been slain and his army routed and
made to pass under the yoke by the helvetii did not think that their request ought to be granted
nor was he of opinion that men of hostile disposition if an opportunity of marching through the pro-
vince were given them would abstain from outrage and mischief yet in order that a period might in-
tervene until the soldiers whom he had ordered to be furnished should assemble he replied to the
ambassadors that he would take time to deliberate if they wanted anything they might return on
the day before the ides of april all warfare is based on deception hence a wise general makes a point
of foraging on the enemy he wins his battle by making no mistakes in battle there are not more than
two methods of attack the direct and the indirect yet these two in combination give rise to an en-
dless series of maneuvers let your plans be dark and impenetrable as night and when you move fall
like a thunderbolt ponder and deliberate before you make a move this is called ability to accom-
plish things by sheer cunning when these five kinds of spy are all at work none can discover these se-
cret system this is called divination of the threads it is the sovereign's most precious
faculty hence it is only the enlightened ruler and wise general who will use the highest intelli-

After transformation by the sequence [module 2+module 3+module 4], the resulting encrypted data file

'output.dat' is shown below (it is fully recoverable by applying the decryption sequence [module 4+module 3+module 2]).

bdjo5gb4pthy6zksnj816l5ghkwfen06tii0251phqluozwfn3o2cglee6so218081dyglitrm4icrjl
ru5hc8dkr868iqxs1tlnf2hzglpzjlilavuj4p8jjmn3qudgpiv3y056oqc9ogosdiu4x0qmvmyjxljw
qikchri7hrdxhmjjz2kw1forywo9uoyqniw80qo9rk56z9kcxfaw9om4f4d6cunfj6gzyw5myblb7z
0i29x3b21pjz37ppjq4w2ejjg5fgholgy7qngore1hz7bqe6c5tnvo2cn3imf16jj2rgmtrx3z2w5sjb

aoolo7o604ldnjprvxpzbyl3wv1terbfuccbv8t2yrd0rbs0buthclzrmao1lhqz53zzqjilk7w2qrj
d18laav6q8der61pitjlaocj89wb6q9zok997jm5fb265m06rpf3i3lvynhngi58wnmg5ra02tjorgx
44jhzapap5sch42dee54gpxs3vwvcs61slw6w5yggf3dgm6dkvwx2mcpgatnora9nwsdoppcln41inp9
4gyvu0keq5lkeojdho7uli7eyv75esgleyaaff72cy336pselvoasukqedotda4b3lan5x10f1j2vdx
be3b84rmdj4pj3394rlu0mj9rffl0czmqwtp7y9ye7ui5l0v5l5q74egahvrlff4z4wvcwq160ecbu
g62ub9at9jd811licsw9fuz659gfw5gf5ejgl41kh3ohmyfpc8s5nkpclcc3pa596aq0s7cgj1oplxl
c9q6wkcz2f4a8whm4nuap9kz6fyumthwdnzva25ip96r8vvjy00bcmiyf5uca6fc7e0teadv5mzzu99fp
qwmvqpovotkpf sazivz9t3dciuljzm8c6u883g0fgpegmu6jirjxbv6vxikz0rlfbc2lksz1304f608kk
6c4mokakn6gsmr0nhibr8laudoxfv5twhvjgkx8d67xh74wra30oajdf6ayt6ketwzi22avzvy033vqaq
yawewndqrjtlnz82bqw8776wu8o9314fqkdow628i3nwq72so3omz28qpeqaklkk115o9oixep7kku
1fshqriev45347rcb7c3s6fh7nj7vx9q5i3n6858ohhiswqf9r5vpw6s8wv98qvfra0ab0ae68bimolv
4nm26rlpsl1s1l9f5wv3ul80vxoacua4svcr0q58we6aqjqpddwk79mgllh13681d88jq6urq713daod
qpr6y9y27k9fjjyijfr0y6iy3v6umv09ppk204hszpt8aqj8f15glvile5bn0uj8kkhb6713a871mmyx
fx54t5tb6xlmvhkdbrcudlywdwbmed8lu4gwindz7ycalex5l23a153wmmq94wq0sljuhuuh96685j
zdzevkxz34w9b1flq16u02g21oyuncv8z3b1lx1cnbc15ab9orswzinl6s6ucbg96bflgv5q6cw5v9icf
pbo5xl6mf0brhaw8ou6031qywb6gvpfc2soodl9sth0w6lqn93p319zwitpezfu9fonbgwnc6x97dubz
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63d5qods8r361ljnutv9g6v76cg931ts5yebofl1rhm2t9hys776d340efiq3h5de608196bgc2pjlz
9iemv99blfsl1de5wv3ul80vxoacua4svcr0q58we6aqjqpddwk79mgllh13681d88jq6urq713daod
k16ny67c328019v5nsj2jvqhfhf888skyhgairrl6o808ut2dtawqjt80bnjdxlo21ou3rsu7onmvmnp
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kx3v05rrj3j6m6aypjbs4qc0ds15q0bu3mnbhkrybgl9avh2rk2bkow4t27gc28ypeptnexusw1493kk
3voc4bdhp2t9cvahk37lcpzpt6vch0v0gb4p07ohzjig3j71f90ala8m5uofv4j5nvzdhar1bw23sfi7
jfv5l0swb0q6b9xstsj4apb8jg0vhxq0ma6pfdtrbp21jziuwrm2chkw7girvni2z1jprv9y6qmbqv
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90xrxw3ch6vyzbpsurg5zngqyet409mi78tkiw4x8at1het5n2fgmticyeaf1wdr8v4ewgdgcr7v2fky
0i9trcb15c1c6xp7vlc6mljia619viwrinyxfqxcswdz276iejghtj9u9t7c20a244856cj0fvl6wm0
ewlnxps98avw8vbx3euplphjct006sy9xutld63bu3iy176hmaxi61lzkzpldgy1bwe0rfxh
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0msgcrqdk432m5skwudje9mt0h3tfhhilbnc58136tg1zye550jiu66w5v2ipevns16gerbc42qlivb5
z84fsnwlfdgdld6zq5kjf8wjghwbfuev3igknz6vz3wol8ebii8e9hxpwpaggaa7nfjl1063soywj2h58h
15yp3hysnkduxd3il70woz29lpy92yssrls2uxqlhtp385p2pj1517zj97ah176q6b68syxrk5gdjhlq
p9mp64b7mbx5gh04y53x76e5ucymowgw2cbmnd878e53rgmjtejlktcuqoozdr7rifrp7wce58ls0xi5
ruwjyztmsys3ld9aimrrj00c767qii6yzk65g9zv5f8jwhp5j5srhq2ilrpxbe68ovbpxwvauuz2d25k8
lrwg05p2z455vjufflmsbnjl9x49amuxfssu3i4mlbgohpeuczute57naododyjdrwvvd14aasv7g
9xu4rqj6kzpo5uyyqbq2vng6u8rogo3lsvtt9lx6y4y23tmlgibilu464sbw19sld13hdk1k5k9oo65x7
p2uv3cg7vilugoe6x8lmn9vbptpafptm06onkt9qyjlrrhrx9vx3d12u4apxndpbdsw2si41qwu761n3
vjp5a7uh61autorco8uyfswrh3of1f2clnglaomuyno2x25r4910sqahcljnu0xyysg5r688usvyygol
5ty70hzlkmkizyhvbi7g53ixsbsf69xilnfg0ylg3n4m749or0hc8pgj3spv4v4kjj2e7871lp1pvib9lk
arjidud3dk1w6vndlpbtd6v6pcrgljkurz1whtrb4kl0t2mma88f342tdmzde3kcbzu0a27mq5ec4qhz
07mgufmzv5roqtlebsyos1tbqfuwolw459o4qrmucz7g0zcziey7xcd8cpigibnyrms4rkboxaly8z9mx
kz3ah9h3nsx533yrdm7uzdfe4crwyblw4dkrc0rpp2vmz18m4w8ya7fe4yyffs2y530fgj00845mmwh7
g2xe3rdnludhlfy45v2q4m2g5s0urhvm9pabpu00dc5mxxxwg30ghvbwlg66ifgfvmls2emuto9up
2uca6zm87f4g5lnks9xzuinbasq3nuqhenlaok3g90fmmnj6pj2u6p92t68yxw41rl3w5hseli13d2qw
0brhqj8yanzrz1ltupha2b7bxnugmttw7e66dqajzx4fcnpoe1rq6apsrht909ejk09wppynpy50i3jo
983kcmittwerf4pxu72s39i4ha2vlj1peo8qazjg36ppzlhna0gi9kxntzi4rv789hg6gezswlnylkr
10lc9360uk83a7hj2h0i0xstc8tq6fds4zji1fbd00xohadveza7p7qmf8gkuxtsk034r06sajdc6ggxb
bgkjj5f6175ccv3qqrakvwvq8bio4zupjhpcwlp2yggz059t6wrmpf52x74jtvnntsy5a0171ilb5e
88v2eaaj5dehwmki3s6gq38ev06q06peffckzmgafc7ys8n6qtr5p3qpca3ovwr8n9golzynkn7ose1
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